REMARKS

I. Introduction

By the present Amendment, claims 1 and 26 have been amended. No claims have been added or cancelled. Accordingly, claims 1-6 and 26-29 remain pending in the application. Claims 1 and 26 are independent.

II. Office Action Summary

In the Office Action of February 25, 2010, claims 1, 4, 5, 26, and 27 were rejected under 35 USC §102(b) as being anticipated by Ko. Claim 2 was rejected under 35 USC §103(a) as being unpatentable over Ko in view of Henry et al. ("Henry"). Claim 3 was rejected under 35 USC §103(a) as being unpatentable over Ko in view of U.S. Patent number 6,801,650 issued to Kikuchi et al. ("Kikuchi"). Claims 6, 28, and 29 were rejected under 35 USC §103(a) as being unpatentable over Ko in view of Xu et al. ("Xu"). These rejections are respectfully traversed.

III. Interview

Applicants would like to thank Examiner Park for the courtesy and cooperation extended in the interview conducted on July 22, 2010. During the interview, Applicants proposed amending the independent claims to explicitly define the rule-based classifier as an "if-then classifier." Applicants also argued that the reference to Ko did not disclose features such as an if-then classifier, or classification of defects using both an if-then classifier and a learning type classifier. The Examiner indicated that such an amendment would likely raise issues with indefiniteness and would not be sufficient to define over the art of record. It was agreed that further details should be incorporated into the claims. In particular, the Examiner noted that

the Specification provides various details regarding the rule-based classification and learning type classification that did not appear to be disclosed in the cited references. No specific agreements were reached regarding claim amendments that would place the application in condition for allowance.

IV. Rejections under 35 USC §102

Claims 1, 4, 5, 26, and 27 were rejected under 35 USC §102(b) as being anticipated by Ko. Regarding this rejection, the Office Action asserts that Ko discloses a method for classifying defects using a defect review apparatus that includes obtaining an image of a defect on a sample using one of an electron type image detector and an optical image detector, extracting a characteristic of the defect from the image using a character extractor, and classifying the defect in accordance with the extracted characteristic, and based on a rule-based classification and a learning type classification. The Office Action further assert that the step of classifying further includes calculating a set of first likelihoods of the defect belonging to each of a plurality of defect classes of the rule-based classification, calculating a set of second likelihoods of the defect belonging to each of a plurality of defect classes of the learning type classification, calculating a third set of likelihoods of the defect belonging to each of the defect classes of the learning type classification and/or the defect classes of the rule-based classification, by use of the first and second likelihood, and classifying the defect by use of the third likelihoods. The rule-based classification and learning type classification are also indicted as being present in a parallel relationship with each other and independent of each other. Applicants respectfully disagree.

By the present Amendment, Applicants have amended the claims to better define the invention and clarify the features that are not shown or suggested by the art of record. As amended, independent claim 1 defines a method of classifying defects, using a defect review apparatus, that comprises the steps:

> obtaining an image of a defect on a sample using one of an electron type image detector and an optical image detector;
>
> extracting a characteristic of the defect from the image using a characteristic extractor; and
>
> classifying the defect in accordance with the extracted characteristic, and based on a rule-based classification and a learning type classification,
>
> wherein the step of classifying further comprises:
>
> calculating a set of first likelihoods of the defect belonging to each of a plurality of defect classes of the rule-based classification, by use of the extracted characteristic using a likelihood function which applies a plurality of if-then rules to calculate an index corresponding to a degree of probability that the defect belongs to a particular defect class;
>
> calculating a set of second likelihoods of the defect belonging to each of a plurality of defect classes of the learning type classification, by use of the extracted characteristic, wherein the learning type classification determines a distance to a center of a normal distribution of data for each defect class;
>
> calculating a third set of likelihoods of the defect belonging to each of the defect classes of the learning type classification and/or the defect classes of the rule-based classification, by use of the first and second likelihoods; and
>
> classifying the defect by use of the third likelihoods; and
>
> wherein the rule-based classification and learning type classification are present in a parallel relationship with each other and independent of each other.

According to the method of independent claim 1, an image of a defect on a sample is first obtained using either an electron type image detector or an optical image detector, and a characteristic of the defect is extracted from the image using a characteristic extractor. Next, the defect is classified in accordance with the

extracted characteristic, and based on a rule-based classification and a learning type classification. The classification step also includes several substeps. Specifically, a set of first likelihoods that the defect belongs to each of the plurality of defect classes of the rule-based classification is calculated using the extracted characteristic and using a likelihood function. The likelihood function applies a plurality of if-then rules in order to calculate an index corresponding to the degree of probability that the defect belongs to a particular defect class. Next, a set of second likelihoods is calculated that the defect belongs to each of a plurality of defect classes of the learning type classification using the extracted values. The learning type classification determines a distance to a center of a normal distribution of data for each defect class. A set of third likelihoods of the defect belonging to each of the defect classes of the learning type classification and/or the defect classes of the rule-based classification is calculated using the first and second likelihoods. The defect is then classified using the third likelihoods. Furthermore, according to independent claim 1, the rule-based classification and learning type classification are present in a parallel relationship and are also independent of each other.

As discussed in the Specification, the likelihood is an index which indicates the degree of probability of belonging to the class, and can fall, for example, within a range of 0 to 1. The closer the value of the index is to 1, the higher the degree of probability of belonging to its class. A function for calculation of the likelihood from a value of a characteristic amount is called the likelihood function and provided by the system. See paragraph [0090] of the published application. Additionally, exemplary if-then rules that can be applied are discussed in the Specification. See paragraphs [0052] – [0055]. The Specification also discusses the manner in which the learning type classification determines the distance to the center of the normal distribution of

the collected data set for each defect class, as well as the use of the Mahalanobis distance for making this determination. See paragraphs [0092] – [0094].

As discussed during the Interview none of the cited references appeared to discuss the use of both rule based and learning type classifications. In particular, Ko discloses an adaptive learning mechanism and a supervised learning method, which are both learning type classifiers. Ko is completely silent on the use of rule-based classifications and likelihood functions. Ko simply fails to provide any disclosure or suggestion for features recited in independent claim 1, such as:

> calculating a set of first likelihoods of the defect belonging to each of a plurality of defect classes of the rule-based classification, by use of the extracted characteristic using a likelihood function which applies a plurality of if-then rules to calculate an index corresponding to a degree of probability that the defect belongs to a particular defect class;
>
> calculating a set of second likelihoods of the defect belonging to each of a plurality of defect classes of the learning type classification, by use of the extracted characteristic, wherein the learning type classification determines a distance to a center of a normal distribution of data for each defect class;
>
> calculating a third set of likelihoods of the defect belonging to each of the defect classes of the learning type classification and/or the defect classes of the rule-based classification, by use of the first and second likelihoods; and
>
> classifying the defect by use of the third likelihoods; and
>
> wherein the rule-based classification and learning type classification are present in a parallel relationship with each other and independent of each other.

It is therefore respectfully submitted that independent claim 1 is allowable over the art of record.

Claims 2-6 depend from independent claim 1, and are therefore believed allowable for at least the reasons set forth above with respect to independent claim

1. In addition, these claims each introduce novel elements that independently render them patentable over the art of record.

As amended, independent claim 26 defines an apparatus for classifying defects that comprises:

> an imager which obtains an image of a defect on a sample;
>
> a characteristic extractor which extracts a characteristic of the defect from the image;
>
> a classifier which classifies the defect in accordance with the extracted characteristic, and based on a rule-based classification and a learning type classification, and
>
> a display for displaying the image of the defect and the classification result on a screen;
>
> wherein said classifying means comprises:
>
> a rule-based classifier which calculates a set of first likelihoods of the defect belonging to each of a plurality of rule classes by use of the characteristics of the defect using a likelihood function which applies a plurality of if-then rules to calculate an index corresponding to a degree of probability that the defect belongs to a particular class,
>
> a learning type classifier which calculates a set of second likelihoods of the defect belonging to each of a plurality of defect classes by use of the characteristic of the defect, wherein the learning type classifier determines a distance to a center of a normal distribution of data for each defect class; and
>
> a calculator which calculates a set of third likelihoods of the defect belonging to each of said defect classes and/or rule classes, by use of the first and second likelihoods, and
>
> a classifier which classifies the defects by use of the calculated third likelihoods; and
>
> wherein the rule-based classification and learning type classification are present in a parallel relationship with each other and independent of each other.

By the present Amendment, independent claim 26 has been amended to incorporate additional details regarding operation of the rule-based classifier and the learning-type classifier. These amendments also correspond to those incorporated

into independent claim 1. As previously discussed, the cited references fail to provide any disclosure or suggestion for such features.

It is therefore respectfully submitted that independent claim 26 is allowable over the art of record.

Claims 27-29 depend from independent claim 26, and are therefore believed allowable for at least the reasons set forth above with respect to independent claim 26. In addition, these claims each introduce novel elements that independently render them patentable over the art of record.

V. Rejections under 35 USC §103

Claims 2, 3, 6, 28, and 29 were rejected under 35 USC §103(a) as being unpatentable over Ko in view of various secondary references. As previously indicated, however, Ko fails to disclose or suggest various features that are now recited in independent claims 1 and 26, from which these claims began. Applicants' review of these secondary references has also failed to reveal any disclosure or suggestion for the same features. Accordingly, these combinations of references still fail to render the claimed invention obvious.

It is therefore respectfully submitted that these references are further allowable over the art of record.

VI. Conclusion

For the reasons stated above, it is respectfully submitted that all of the pending claims are now in condition for allowance. Therefore, the issuance of a Notice of Allowance is believed in order, and courteously solicited.

If the Examiner believes that there are any matters which can be resolved by way of either a personal or telephone interview, the Examiner is invited to contact Applicants' undersigned attorney at the number indicated below.

AUTHORIZATION

Applicants request any shortage or excess in fees in connection with the filing of this paper, including extension of time fees, and for which no other form of payment is offered, be charged or credited to Deposit Account No. 01-2135 (Case: 500.43701X00).

Respectfully submitted,
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